THE BULLETIN

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Hydro-Electric Power Commission of Ontario

July-August
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Humphrey Falls, Manitoulan Island, near Manitowaning

THE BULLETIN

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TO OUR READERS.

We wish to extend to all our readers our sincere regret that THE BULLETIN has been published so irregularly of late. The Printers' Strike in Toronto is the chief cause and, much as we regret to keep our readers waiting, it is impossible to issue THE BULLETIN on a definite schedule while strike conditions exist.

In an effort to keep abreast of our publication programme, we have adopted the expedient of combining two numbers together for greater ease in handling the work, and we shall pursue this method until printing conditions are back upon a normal basis.

In the meantime we wish to express our hearty thanks for the indulgence of our readers, and to assure them that no effort is spared to get out THE BULLETIN as often as possible and likewise that it is our earnest effort to make each issue decidedly worth while.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES.

The Canadian Engineering Standards Association has supplied us with a limited number of copies of "Standard Requirements for Single-Phase Distribution Transformers."

Any Member of the A. M. E. U. desiring a copy of the same, please communicate with

S. R. A. CLEMENT,

Secretary.

190 University Avenue, Toronto.

Our New Commissioner.

We wish to extend a welcome to our new Commissioner, Mr. Fred R. Miller. Mr. Miller is one of the outstanding figures of the younger generation of business men in this city. He is vice-president of the firm of Roger Miller & Sons, Ltd., Contractors, and president of Ownes-Elmes Limited.

Mr. Miller was born in St. Catharines, Ontario, in 1879 and received his early education in the Ingersoll, Ontario Public and High Schools. He entered the University of Toronto in the fall of 1899, taking the course of Civil Engineering at the School of Science. Graduating from this institution in 1902 he became associated with the firm of Haney & Miller, Engineers and Contractors in this city. Later he was made manager of the Port Credit Brick Company and became a partner in his father's firm, Roger Miller & Sons, Limited, in 1917.

In 1916 he took charge of the Toronto district production for the Imperial Munitions Board, directing the output of shells for the entire province. During 1917 and 1918 he acted as vice-president and general manager of the British Forgings plant in Ashbridge's Bay. In both capacities he gave his services to the Government entirely without recompense. Mr. Miller is also serving on the Transportation Commission of the City of Toronto without salary.

Mr. Miller at the "School" was known as "Scrappy" Miller by his friends. He was always prominent in sports. He is a motor boat enthusiast and owns some of the fastest craft on the bay. His "Heldena II" won the Canadian International Gold Challenge Trophy and the C. N. E. Challenge Cup. In addition to his interest in motor boating he is an enthusiastic motorist and golfer. He is a member of the Engineers' Club, the Mississauga Golf and Parkdale Canoe Clubs.

Fred R. Miller, Esq.

At the same time that we extend greetings to Mr. Miller we regret the loss of Mr. Lucas from the Commission. The Honorable I. B. Lucas was appointed a member of the Commission in 1914 and has resigned to go into private practice again. Mr. Lucas was elected to the Ontario Legislature in 1898 and re-elected in 1902, 1905, 1908 and 1911; appointed to the Whitney Cabinet in 1909 as

Minister Without Portfolio; as Provincial Treasurer in 1913; Attorney General 1914.

Mr. Lucas was an energetic and untiring worker, and a staunch supporter of Hydro ideals. His genial personality will be greatly missed by all.

NOTES FROM BRITAIN ON LIGHTING PROGRESS.

At a meeting of the Illuminating Engineering Society, in London, the committee on electric lamps and lighting appliances stated that considerable progress has been made in the past year; supplies of lamps have notably increased and the output of gas-filled lamps in particular has risen by five to six times. Fittings suitable for use with the smaller gas-filled lamps have also been introduced. Some small gas-filled lamps with opal bulbs were exhibited by the Edison Swan Electric Co., Ltd., and J. S. Dow showed two small 220-volt neon lamps which had been loaned to him by this company. While still in the experimental stage these small neon lamps have some very interesting features. They can be inserted in an ordinary lamp circuit and resemble a small gas-filled lamp in general appearance. The light, however, is not derived from a filament but from an electrical discharge through rarified neon gas, the light appearing as a soft orange glow. The light from these small lamps is at present feeble, apparently less than 1 cp., but, as they can be made to consume only 5 watts on 220 volts, it is believed that they will prove useful as pilot lights and in other places where only a very small candlepower is needed. In particular, they appear to have promising applications to electric signs, as the lamps can be so made that the "glow" appears in the form of luminous letters of the alphabet. Mr. Dow also exhibited and described a direct reading "foot-candle meter" of the type familiar in the United States.

Major Adrian Klein demonstrated the latest form of Sheringham daylight. This "artificial-daylight" device achieves its object by the reflection of light from a gas-filled lamp off the inner surface of a laige reflector placed above the lamp, which is painted emerald green and ultramarine with a small percentage of red. In the latest apparatus the preparation of this colored surface has been reduced to a standardized form. A special color-medium which is unaffected by the heat of the gsa-filled lamp retains its permanence under the action of its light and gives a matte surface as used. The pigment is applied to a surface comprising perforated zinc superimposed over asbestos, and the bolts and nuts which hold this in position are colored red, thus providing the necessary small correcting color element. The apparatus appears to be answering satisfactorily in practice, and new applications in industry are continually being recorded.—*Electrical Review.*

A sickroom clock invented in Switzerland has an electric lamp beside a translucent dial, so that when an invalid in bed presses a button the dial throws the shadow of the hour and hands, magnified, upon the ceiling.

Rates for Electricity Compared

By A. S. L. BARNES and L. S. LOCKE,
Hydro-Electric Power Commission of Ontario.

IT is well known that the municipalities supplied by the Hydro-Electric Power Commission of Ontario enjoy, in general, cheaper rates than those prevailing elsewhere in Canada and the United States, but it was felt that it would be interesting to make an actual comparison in order to find out definitely what the relation of the Commission's rates is to those charged by other municipal and private corporations.

A number of municipalities of various sizes were selected at random, and the distributors of electricity in each place were circularized regarding the rates charged by them at the end of 1920. Eighty complete replies were received, forty from Canadian towns and forty from towns in the United States, and these are taken as representative of all the towns and cities in their respective countries. It should be specially noted that the selection of municipalities was purely at random and without reference to any previous knowledge of the rates.

Basis of Comparison

Owing to the diversity of form of schedules of rates received from the various places, a mere tabulation, besides being cumbersome, would not convey a clear idea of the actual prices of electricity; the most satisfactory basis of comparison is to compute the net monthly bills which would be rendered to typical consumers in each class of service. This has been done, taking into consideration all energy charges, service charges, meter rents, prompt payment or other discounts, flat rates where they are lower than meter rates, etc. Where optional rates are offered to consumers the one which gave the lowest net bill was taken. Where in the case of steam plants, a "coal clause"* is appended to the rates, it has not been taken into account, and consequently the cost to the consumer as shown is less than that actually charged under 1920 conditions.

Table I. describes the relevant details which have been used in computing the specimen bills of the "typical consumers" from which the averages of Table III. were derived.

TABLE I.

Consumer No.	Type of Service	Floor Area Sq. Ft.	No. of Rooms	Monthly Consumtion K.W.H.	Installation or Maximum Demand	Lead Factor
1.	Small Lighting	1200	6	20	0.3 K.W.	
2.	Average Lighting	1600	8	30	0.5 K.W.	
3.	Light and Domestic Appliances	1600	8	70	2.0 K.W.	
4.	Lighting and Cooking	1600	8	180	6.5 K.W.	
5.	Commercial Light	-------	--	100	0.6 K.W.	
6.	Secondary Power**	-------	--	500	5 H.P.	1 %
7.	Secondary Power**	-------	--	5,000	50 H.P.	18%
8.	Primary Power***	-------	--	50,000	500 H.P.	18%
9.	Primary Power***	-------	--	100,000	500 H.P.	37%

* **Coal Clause.** A contract clause or "rate rider" providing that for every increase above or decrease below a stated base price for coal (usually taken as the "normal" or average pre-war price) a stipulated corresponding (usually proportional) increase or decrease will be made in the quoted rate schedule.

** Power at distribution voltage (110 or 220 volts).

*** Power at transmission voltage.

Method of Comparison

The cost of electricity, and hence the rates at which it can be sold, is in great measure determined by three factors, viz.:

(1) Distance of market from power development or source of fuel.

(2) Size and concentration of market.

(3) Source of energy (i.e., whether derived from water, coal, oil or gas).

In the following compilation it was found impracticable to make allowance for the first factor; it should be noted, however, that the distances to which power is transmitted from Niagara Falls by the Commission are much greater than those which occur under average conditions, and it is consequently so much the more to the Commission's credit that the rates for such places are, as will be seen below, so cheap.

With regard to the second factor (size of market) the method was adopted of dividing the places served into six arbitrary groups according to the capacity of the plant installed. Where the latter was not known it has been assumed (for purposes of classification only) to be one-third in excess of the peak load. Table II. sets forth the formation of the groups and the number of municipalities in each group.

TABLE II.

Group No.	*I.*	*II.*	*III.*	*IV.*	*V.*	*VI.*
Capacity (Kv-a)...........	Less than 300	301 to 1000	1001 to 3000	3001 to 10000	10001 to 30000	over 30000
Number of Municipalities	17	19	14	12	8	10

The third factor has been taken care of by keeping separate the municipalities using hydro-electric, steam-generated, and oil and gas generated power. Table III. shows the number of places in each class.

TABLE III.

Kind of Plant	*Number of Municipalities.*
Steam Engines or Turbines	40
Water-power	36
Oil Engines	3
Gas Engines	1
Total	80

The Municipalities served by the Commission were similarly classified according to power demand and the bills worked out which would be paid by the nine typical consumers. The maximum, minimum and average bills charged in each group of towns, for each type of consumer, are set forth in Table IV., as compared with similar bills in the eighty non-Hydro towns

Table IV. Average Monthly Bills

CONSUMER	GROUP	HYDRO MUNICIPALITIES Max.	Min.	Av.	MUNICIPALITIES OTHER THAN HYDRO — All Others (80) Max.	Min.	Av.	Canada (40) Max.	Min.	Av.	United States (40) Max.	Min.	Av.	Steam Plants (40) Max.	Min.	Av.	Water Power (36) Max.	Min.	Av.	Gas and Oil (4) Max.	Min.	Av.
No. 1. Small Lighting 20 K.W.H.	I.	1.76	0.68	1.26	3.96	0.69	2.57	3.60	0.69	2.56	3.96	1.59	2.59	3.60	1.80	2.90	3.40	0.69	1.95	3.96	3.50	3.73
	II.	1.22	0.68	0.96	3.24	0.60	2.07	3.24	0.60	2.05	2.80	1.59	2.13	3.24	1.81	2.45	2.40	0.60	1.84	2.85	2.24	2.54
	III.	1.22	0.68	0.82	3.00	.90	2.04	2.75	.90	1.83	3.00	1.80	2.25	3.00	1.80	2.29	2.48	0.90	1.63			
	IV.	0.77	0.68	0.70	2.45	1.08	1.84	1.89	1.08	1.44	2.45	1.60	2.04	2.45	1.60	1.97	2.21	1.08	1.57			
	V.	0.68	0.68	0.68	2.23	1.26	1.62	1.33	1.26	1.30	2.23	1.44	1.73	2.23	1.33	1.75	1.50	1.44	1.47			
	VI.	0.68	0.68	0.68	2.20	0.60	1.50	1.20	0.60	.90	2.20	1.12	1.66	2.20	1.20	1.73	1.20	0.60	0.97			
No. 2. Average Lighting. 30 K.W.H	I.	2.59	0.97	1.79	5.90	0.97	3.73	5.40	0.97	3.75	*5.90	1.85	3.70	5.40	2.70	4.18	4.05	0.97	2.78	5.90	5.00	5.45
	II.	1.78	0.97	1.34	4.86	0.85	3.00	4.86	0.85	2.91	4.20	2.55	3.19	4.86	2.66	3.59	3.60	0.85	2.63	4.15	3.36	3.75
	III.	1.78	0.97	1.17	4.50	1.35	3.07	3.83	1.35	2.75	4.50	2.70	3.37	4.50	2.57	3.42	3.38	1.35	2.58			
	IV.	1.11	0.97	0.99	3.48	1.62	2.71	2.70	1.62	2.27	3.48	2.40	3.03	3.48	2.40	2.89	3.30	1.62	2.35			
	V.	0.97	0.97	0.97	3.53	1.89	2.44	2.00	1.89	1.95	3.53	2.16	2.60	3.53	2.00	2.64	2.25	1.89	2.16			
	VI.	0.97	0.97	0.97	3.30	0.90	2.17	1.80	0.90	1.35	3.30	1.67	2.38	3.30	1.80	2.48	1.80	0.90	1.46			
No. 3 Light and Domestic Appliances 70 K.W.H	I.	4.68	1.49	2.96	13.28	1.41	8.39	12.60	1.41	8.36	13.28	3.75	8.45	12.60	6.30	9.58	10.90	1.41	6.26			
	II.	3.09	1.49	2.28	11.34	1.65	6.61	11.34	1.65	6.43	9.40	3.75	6.94	11.34	6.46	8.19	8.40	1.65	5.55	13.28	11.00	12.14
	III.	3.09	1.49	1.88	9.50	3.15	6.48	8.22	3.15	5.66	9.50	6.00	7.39	9.50	4.73	7.22	7.40	3.15	5.39	9.35	7.84	8.60
	IV.	1.81	1.49	1.54	7.70	3.78	5.70	6.30	3.78	5.13	7.70	4.90	6.11	7.40	4.78	5.89	7.70	3.78	5.32			
	V.	1.49	1.49	1.49	6.46	4.41	5.30	4.66	4.41	4.54	6.46	5.04	5.55	6.46	4.66	5.53	5.25	4.41	4.90			
	VI.	1.49	1.49	1.49	7.70	2.10	4.35	4.20	2.10	3.15	7.70	3.35	4.64	7.70	3.38	4.87	3.92	2.10	3.12			
No. 4 Lighting and Cooking 180 K.W.H	I.	8.64	3.00	5.74	31.36	2.27	16.21	29.16	2.27	16.50	31.36	7.05	15.63	29.16	7.65	20.29	18.00	2.27	8.92	31.36	27.00	29.18
	II.	8.86	2.48	4.35	29.16	3.30	10.60	29.16	3.30	10.86	15.34	7.05	10.09	29.16	8.46	13.48	21.60	3.30	8.76	14.90	7.41	11.16
	III.	5.56	2.48	3.25	21.60	3.38	10.79	11.40	3.38	7.22	21.60	7.80	14.25	21.60	6.66	13.53	10.50	3.38	6.76			
	IV.	3.00	2.48	2.56	19.80	4.72	9.66	11.70	4.72	7.19	19.80	7.54	11.37	14.50	6.12	9.25	19.80	4.72	10.48			
	V.	2.48	2.48	2.48	15.34	4.59	11.31	6.27	4.59	5.43	15.34	11.78	13.27	15.34	6.27	12.07	12.96	4.59	10.05			
	VI.	2.48	2.48	2.48	15.50	3.40	9.01	6.30	3.40	4.85	15.50	5.55	10.05	15.50	6.30	10.19	9.84	3.40	6.26			

CONSUMER	GROUP	HYDRO MUNICIPALITIES Max.	Min.	Av.	MUNICIPALITIES OTHER THAN HYDRO — All Others (80) Max.	Min.	Av.	Canada (40) Max.	Min.	Av.	United States (40) Max.	Min.	Av.	Steam Plants (40) Max.	Min.	Av.	Water Power (36) Max.	Min.	Av.	Gas and Oil (4) Max.	Min.	Av.
No. 5 Commercial Lighting 100 K.W.H.	I.	6.19	1.94	3.94	18.68	2.30	11.94	18.00	2.30	11.99	18.68	5.21	11.82	18.00	9.00	14.81	14.50	2.30	7.84	18.68	15.00	16.84
	II.	3.87	1.75	2.74	15.00	3.25	9.38	15.00	3.25	9.34	13.00	4.61	9.63	15.00	8.60	10.66	12.00	3.25	7.81	13.25	12.00	.12.63
	III.	3.87	1.27	2.13	12.50	4.50	8.69	11.33	4.50	7.24	12.50	8.01	9.93	12.50	6.08	9.85	9.67	4.50	7.34			
	IV.	2.82	1.06	1.66	11.00	4.72	7.62	9.00	4.72	7.09	11.00	5.82	8.00	9.00	5.82	7.84	11.00	4.72	7.18			
	V.	1.55	1.06	1.31	11.45	6.30	8.20	6.65	6.30	6.48	11.45	7.00	8.78	11.45	6.30	9.03	7.20	6.30	6.83			
	VI.	1.93	1.93	1.93	11.00	3.00	5.99	6.00	3.00	4.50	11.00	5.31	6.91	11.00	5.31	7.18	5.60	3.00	4.70			
No. 6 Power 5 H.P. 500 K.W.H.	I.	29.57	8.40	17.24	80.78	10.42	38.89	80.00	10.42	38.76	80.78	15.50	39.07	80.00	28.98	51.65	50.00	10.42	23.72	80.78	54.50	67.64
	II.	17.78	7.71	12.14	45.00	11.81	23.52	45.00	11.81	23.17	33.95	15.50	24.05	45.00	23.75	28.52	33.95	11.81	19.72	30.50	22.05	26.28
	III.	15.26	5.46	10.43	42.75	9.00	25.47	41.40	9.00	20.80	42.75	21.38	30.14	42.75	16.74	29.86	29.50	9.00	20.46			
	IV.	10.11	6.60	8.20	31.35	5.00	22.24	30.00	5.00	20.87	31.35	15.00	23.22	31.35	19.50	25.31	26.13	5.00	16.11			
	V.	7.46	6.13	6.70	35.00	11.50	21.79	13.30	13.30	13.30	35.00	11.50	23.20	35.00	13.30	23.02	26.00	11.50	18.75			
	VI.	9.90	9.90	9.90	35.00	11.97	24.42	19.00	11.97	15.48	35.00	16.20	26.65	35.00	19.00	28.04	19.70	11.97	15.96			
No. 7. Power. 50 H.P 5000K.W.H.	II.	177.80	77.10	121.40	450.00	89.20	165.03	450.00	89.20	179.10	166.25	125.00	143.93	450.00	141.07	215.61	172.80	89.20	131.67	200.50	143.55	172.02
	III.	152.60	54.60	104.30	284.75	76.50	175.66	227.25	76.50	156.90	284.75	125.00	194.55	284.75	125.00	182.90	265.00	76.50	162.68			
	IV.	101.11	66.00	82.00	250.00	50.00	163.19	250.00	50.00	147.71	243.10	125.00	174.25	250.00	147.50	189.63	166.25	50.00	110.31			
	V.	74.60	61.30	67.00	141.07	82.18	115.36	82.18	82.18	82.18	141.07	98.00	120.89	141.07	82.18	115.40	117.50	113.00	115.25			
	VI.	90.05	90.05	90.05	280.00	94.20	183.93	116.78	100.00	108.39	280.00	94.20	202.61	280.00	100.00	212.38	141.65	94.20	117.54			

CONSUMER	GROUP	HYDRO MUNICIPALITIES (50) Max.	Min.	Av.	MUNICIPALITIES OTHER THAN HYDRO — All Others (42) Max.	Min.	Av.	Canada (15) Max.	Min.	Av.	United States (27) Max.	Min.	Av.	Steam Power (28) Max.	Min.	Av.	Water Power (14) Max.	Min.	Av.
No. 8 Power 500 H.P. 50000K.W.H	II.	1526.00	546.00	1043.00	1800.00	508.50	1298.77	1800.00	508.50	1254.56	1518.65	1246.00	1350.38	1746.00	928.35	1367.81	1800.00	508.50	1188.30
	IV.	1011.00	660.00	820.00	1800.00	500.00	1131.22	1800.00	*500.00	1062.66	1500.00	720.00	1180.19	1800.00	1046.25	1273.23	1258.75	500.00	849.69
	V.	746.00	613.00	669.50	1003.12	586.63	817.47	586.63	586.63	586.63	1003.12	593.00	855.95	1003.12	586.63	788.86	905.00	873.00	889.00
	VI.	880.20	880.20	880.20	1641.99	570.00	1158.19	724.55	664.06	694.30	1641.99	570.00	1274.16	1641.99	664.06	1319.29	1052.35	570.00	782.30
No. 9. Power 560 H.F 100,000 K.W.H	III.	1591.20	586.31	1177.22	3600.00	542.25	2112.28	3600.00	542.25	2013.96	2802.15	1871.00	2194.52	3433.50	1871.00	2427.78	3600.00	542.25	1794.44
	IV.	1077.60	704.36	873.56	3600.00	1000.00	1867.45	3600.00	1000.00	1848.10	2430.16	1120.00	1743.94	3600.00	1608.75	2093.23	2317.50	1000.00	1462.83
	V.	779.75	657.00	718.38	1830.51	1048.40	1468.08	1156.63	1156.63	1156.63	1830.51	1048.40	1519.98	1830.51	1048.40	1424.71	1780.00	1373.00	1576.50
	VI.	1078.20	1078.20	1078.20	2802.09	908.44	1716.66	956.48	908.44	932.96	2802.09	1050.00	1912.71	2802.09	908.44	1968.96	1377.35	956.48	1124.61

investigated, taking the latter, first all together, then classified by countries and finally separated according to the source of energy.

The Municipalities served by the Commission were similarly classified according to power demand and the bills worked out which would be paid by the nine typical consumers. The maximum, minimum and average bills charged in each group of towns, for each type of consumer, are set forth in Table IV. and compared with similar bills in the eighty "non-Hydro" towns investigated, taking the latter, first all together, then classified by countries and finally separated according to the source of energy.

GENERAL CONCLUSIONS

The following general conclusions are to be drawn from the table:

(1) Small towns and villages have on the average very much higher rates than cities. The accompanying curve illustrates graphically the relation between the average rates and the size of plant.

(2) Steam power is in general more expensive than water-power, and gas or oil generated power is much more expensive than either.

(3) Canadian rates are slightly less than those in the United States, especially in large cities. The difference would be more apparent if the exchange discount were taken into consideration.

(4) The average bills in Hydro towns are, for *all* types of consumers and for *all* sizes of plant, less, and in most cases very much so, than the average bills of all the other places, even than bills in other places served with hydro-electric energy. The average bill in all non-hydro towns ranges from 22% to 526% greater than the average corresponding bill in "Hydro" towns. In all but two of the forty-nine cases taken the *highest* "Hydro" bill was less than the *average* bill for other towns in the same class, and in twenty-one of the forty-nine cases the *highest* "Hydro" bill was actually less than the *lowest* "non-Hydro" bill.

SAVING THROUGH HYDRO.

Table V. sets forth in concise fashion the average amount charged in "non-Hydro" towns for electricity sold for $1.00 in "Hydro" towns.

TABLE V.

The amount "Hydro" consumers would pay for electricity now purchased for an average price of $1.00, if charged at the average rate prevailing in "non-Hydro" towns.

SERVICE	CONSUMER	GROUP NO. I.	II.	III.	IV.	V.	VI.	Aver.
Small Lighting	No. 1	$2.04	$2.16	$2.49	$2.63	$2.38	$2.21	$2.32
Average Lighting	No. 2	2.08	2.24	2.62	2.74	2.52	2.24	2.37
Light and Domestic Appliances	No. 3	2.83	2.90	3.44	3.70	3.55	2.92	3.23
Lighting and Cooking	No. 4	2.83	2.44	3.32	3.77	4.56	3.63	3.43
Commercial Light	No. 5	3.04	3.42	4.07	4.59	6.26	3.10	4.08
Power	No. 6	2.25	1.93	2.44	2.72	3.25	2.47	2.51
Power	No. 7		1.36	1.68	1.99	1.72	2.04	1.76
Power	No. 8			1.25	1.38	1.22	1.32	1.30
Power	No. 9			1.79	2.14	2.05	1.59	1.89

It seems from Table V. that, on the average, domestic consumers save more than 150% on their bills, commercial lighting consumers over 300% and power consumers about 90%. This shows that contrary to a popular belief the H.E.P.C. has not unduly favored the industrial power users at the expense of domestic and commercial consumers. In 1919 the total expenditure of "Hydro" consumers was approximately 2, 1, and 3½ millions for domestic light, commercial light and power respectively. The saving which "Hydro" consumers make over consumers in other parts of Canada and the United States will thus be not less than 3, 3 and 3 millions respectively or a total of nine million dollars annually. This amounts to $17.10 per domestic consumer, $86.90 per commercial consumer and $462 per power consumer per year on the average. In addition, the Commission's low rates have forced competitors to lower their rates, and a considerable amount has thus been saved by non-Hydro consumers in Ontario. There is little doubt that even in other parts of Canada and the United States competing electricity supply companies have been compelled to lower their rates for power in order to retain power consuming industries which would otherwise have been attracted to Ontario by the extremely low rates which prevail in the Hydro municipalities.

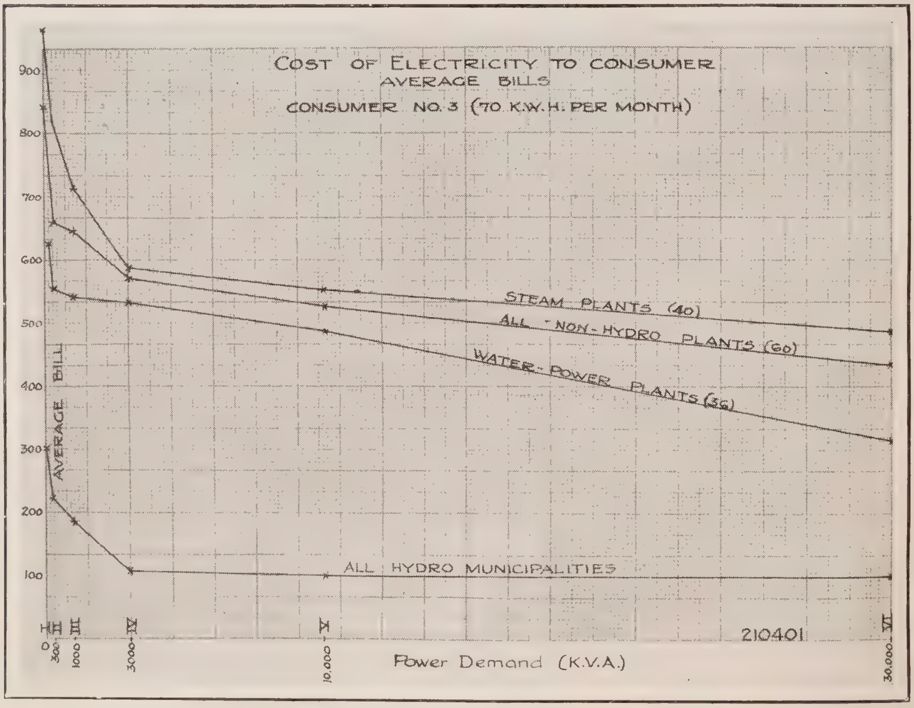


Figure 1—Curve showing how the size of plant or power demand affects the price of electricity

Merchandise Possibilities in Hydro Municipalities.

By G. J. MICKLER

Assistant Auditor Municipal Accounts, Hydro-Electric Power Commission of Ontario.

IT is an acknowledged fact now that it is only a matter of months, and perhaps weeks, when the world's biggest reservoir of electrical energy will be tapped. The Chippawa Development of the Hydro-Electric Power Commission is nearing completion, and when the water commences to flow through the canal and to turn the immense turbines and generators, there will be available power in almost unlimited quantities for distribution among the many Hydro municipalities to redistribute to their thousands of customers.

This enormous supply of power, to be most beneficial and to prove most economical from the customers' standpoint, must be absorbed almost as rapidly as it is produced. It is most reasonable to expect that the sooner all available power is made use of the cheaper will it prove to be in the end, and there is accordingly the increased incentive to further use for that reason.

To bring before the individual customers the need for more continuous use of the electric current for household purposes, and to educate them into the multitudes of uses to which it can be put is a duty that falls on every municipal manager or superintendent, to say nothing of the executives or municipal commissions. Every Hydro Municipality has pledged itself almost unconditionally to support the Hydro enterprise, and every Hydro municipal official is vitally interested in insuring the success of the Hydro developments.

There are several ways in which this success can be made positive, among them being that of inducing every householder and possible user of electricity not now a customer of the Hydro to prepare his premises for its use, and greater still, that of educating all customers into utilizing this element of usefulness to its utmost capacity by introducing into their homes appliances and devices perhaps now unknown to them, or perhaps now beyond their means to purchase.

It lies within the power of a Municipal Hydro System properly equipped to promote the sale and use of electrical appliances in a way that would be the envy of many a wholesaler or retailer. Has the municipal office not the distinct advantage of a visit from almost every customer every time a bill is paid? This customer seldom expects to do more than pay his electric light bill, but if the office is properly laid out, the process of paying a bill would involve passing around the circuit of appliance displays with an occasional interruption by a wide-awake clerk to enquire as to the cus-

tomer's requirements in the electrical line.

Many people there are who pass necessities heedlessly by, simply because they have not been apprised of their existence. Others there are who know what they need, but are afraid to enquire about appliances for fear they must buy or that the price is prohibitive. The municipal Hydro Shop must take these two classes in hand and in a way which gives the impression that the customer's ends only are being considered—bringing before him the advantages and possibilities of up-to-date household appliances and the comparatively easy terms on which they may be purchased.

At the present time there are not very many municipalities which can boast of an up-to-date Hydro Shop, although the possibilities along this line are many, requiring only the vim and vigor of an energetic secretary or manager to awaken the commissioners to the opportunities staring at them unheeded—and it is within the limits of possibility to have a Hydro Shop of some sort in practically every Hydro town or village.

The ordinary retailer is influenced only by the profits he can reap from his participation in a business of any kind, while the Hydro Shop manager has a two-fold reason for engaging in the business of merchandizing electrical devices—first, the increased consumption of current resulting from each sale, and, second, the profits from sales which help materially to reduce general overhead expenses in the Hydro department proper. The former not only increases the revenue, but, by improving the diversity factor between consumers, helps ultimately to cheapen the service for every consumer.

It is a well known fact that a very small proportion of the homes in the lighted municipalities are properly equipped with electrically operated devices. The equipment considered adequate for an average home might be enumerated as follows:—

	Cost
Range	$130.00
Water Heater	30.00
Washing Machine	150.00
Auxiliary Heater	25.00
Vacuum Cleaner	50.00
Percolator	15.00
Toaster	10.00
Iron	8.00
Fan	20.00
Sewing Machine Motor	15.00
Wiring for Heavy Service	47.00
	$500.00

While this equipment might suit the average middle class customer, it may be argued that the smaller user could not afford more than:

	Cost
Washing Machine	$100.00
Iron	8.00
Vacuum Cleaner	50.00
Auxiliary Heater	25.00
Toaster	10.00
	$193.00

and the real small user may not afford more than:

	Cost
Iron	$ 8.00
Toaster	10.00
	$18.00

Combining these three classes and

striking a general average, it is perhaps safe to assume that the cost of an ultimate average electric installation in Ontario would be about $300.00.

It should be the aim of every householder to finally equip his home with the appliances listed above, and it should thus also be the aim of every Hydro manager to have the equipment to sell him.

In the Province of Ontario at the present time there are 270 municipalities, with a combined population of over 1,600,000 people served by the Hydro Commission, and, on the assumption that there are 5 persons in the average family, there are 320,000 families who could receive service from the Hydro lines. With an ultimate equipment value of $300.00, there is possible the sale of $96,000,000.00 worth of electric appliances in Ontario, of which the value of the appliances now in use would perhaps form only a very small percentage, so it is evident that the field for this business is practically unlimited. Then, too, consideration must be given to the fact that these appliances are not everlasting, and many of them must be renewed every five or six years, thus ensuring a perpetual market for their sale. Besides this household appliance business much can be sold to manufacturers in the way of motors and other equipment which would amount to considerable in the way of turnover.

To give some idea of the manner in which this business is being carried on at the present time in Hydro Municipalities, figures are presented below giving the volume and profits during 1920 in all places where appliances were handled:—

MUNICIPALITY	BUSINESS TURNOVER	PROFITS
Acton	2,965.00	221.00
Brampton	1,052.00	27.00
Belleville	51,422.00	....
Beaverton	2,453.00	632.00
Barrie	16,727.00	675.00
Brighton	5,708.00	....
Brockville	3,634.28	608.00
Bowmanville	12,115.00	....
Cannington	2,535.00	115.00
Collingwood	529.00	140.00
Chatham	94,400.00	2,000.00
Clinton	2,583.00	460.00
Carleton Place	9,388.00	....
Chesterville	4,000.00	846.00
Cobourg	11,015.00	....
Dresden	3,506.00	291.00
Dundas	4,137.00	479.00
Elmira	3,046.00	502.00
Elora	4,746.00	505.00
Exeter	8,078.00	477.00
Fergus	5,000.00	....
Forest	15,397.00	131.00
Galt	4,800.00	1,017.00
Goderich	3,640.00	587.00
Georgetown	2,487.00	312.00
Guelph	29,598.00	1,999.00
Hamilton	31,337.00	3,105.00
Ingersoll	7,966.00	780.00
Kingston	14,923.00	1,288.00
Lindsay	11,119.00	....
Listowel	1,104.00	....
Leamington	11,404.00	....
London	333,863.00	25,361.00
Mount Forest	1,165.00	262.00
Mitchell	9,257.00	717.00
Millbrook	1,545.00	....
Mimico	422.00	....
Midland	12,817.00	2,871.00
Milton	10,515.00	748.00
Napanee	20,628.00	....
New Hamburg	8,000.00	1,072.00
North Bay	11,579.00	....
Norwich	830.00	40.00
Ottawa	71,534.00	10,555.00
Oshawa	23,788.00	....
Owen Sound	8,178.00	2,076.00
Orangeville	2,332.00	234.00
Palmerston	14,671.00	1,127.00

Municipality	Business Turnover	Profits
Penetang	1,019.00	97.00
Perth	30,000.00	3,375.00
Picton	29,949.00	5,090.00
Petrolia	9,870.00	2,444.00
Port Hope	13,729.00	....
Powassan	2,471.00	....
Ridgetown	6,838.00	611.00
St. Mary's	3,160.00	....
St. Thomas	17,590.00	262.00
Sarnia	27,200.00	3,196.00
Seaforth	6,800.00	438.00
Strathroy	23,428.00	2,031.00
Smith's Falls	15,000.00	522.00
Tillsonburg	4,000.00	1,242.00
Toronto	314,499.00	21,374.00
Tweed	840.00	....
Walkerville	114,389.00	4,990.00
Wallaceburg	16,946.00	1,001.00
Waterloo	16,087.00	803.00
Welland	12,609.00	1,935.00
Windsor	238,807.00	8,307.00
Woodstock	9,779.00	1,788.00
Total	$1,828,948.00	$121,766.00

From this list by a study of the sales made by each municipality, it is easily seen that in a great many the amount of busines done does not measure up to within a reasonable figure of what one would expect, as indicated by what some others have done.

Take Windsor and Walkerville for example, with a combined population of about 44,000 people, showing sales of $238,807.00 and $114,389.00 respectively or combined sales of $353,196.00. This represents practically nothing but merchandise as the wiring business is not conducted on a large scale.

London, which engages in wiring for heaters, ranges and motors, as well as merchandising, had a turnover of $333,863.00 with a population of 60,000 people.

Chatham, in the business in a smaller way had a turnover of $94,400.00 among 14,000 people, while Kingston with 24,000 people was able to sell but $14,923.00 worth of electrical appliances.

Toronto in her Merchandise Department only had a turnover of $314,499.00 or $38,697.00 less than London, which is one-tenth the size of Toronto, while Ottawa, almost double the size 534.00 in wiring and sales.

Among the smaller towns are shown Barrie—$16,727.00, Midland—$12,817.00, Milton—$10,515.00, Perth—$30,000.00, Wallaceburg—$16,946.00, Picton—$29,949.00, Forest—$15,397.00, Strathroy—$23,428.99 and Waterloo—$16,087.00, as compared with some much larger, namely, Sarnia—$27,200.00, St. Thomas—$17,590.00, Guelph—$29,598.00, Brockville—$3,634.28, Galt—$4,800.00 and Woodstock—$9,779.00. This wide difference in the amount of business done in the different municipalities is an indication to a very great degree of the policy of the local Commission, and of the initiative of the manager or secretary. Some municipal commissioners are adverse to the local Hydro embarking on a venture of merchandising on a large scale fearing criticism from local merchants. 'Tis true the Hydro sells what can be handled by hardware and fixture merchants in every town but in many cases the Hydro sells many appliances while the local merchant keeps on handling what he has in stock, because the buyer—a Hydro light user—had occasion while paying his lighting bill to inspect the stock of appliances and see a demonstration which resulted in

the purchase, while he never had occasion to go to the hardware store and if he had he would never have seen what he wanted because the merchant only sells what people think they want not what they need, and besides the electrical display, being one of many dis plays would perhaps not attract the casual customer in a hardware store.

The case of a fixture store is a little different. People generally do not visit such places unless they have wiring to do. Another reason is they are often influenced into remaining outside because of the excessive charges of wiring contractors which are often reflected in the prices of appliances handled, and furthermore the electrical dealer is more anxious to sell something that will yield a large profit, than that which will produce revenue for the Hydro System by increased consumption. The criticism against local Hydro systems engaged in wiring or merchandise business on account of interfering with the business of local wiremen and dealers is not justified by facts. It is the case that the local board will do extensive advertising and coupled with this is the personal contact with customers and possible purchasers of appliances, to promote the sale of merchandise and wiring and once the local office makes a sale, the article sold often advertises itself or rather the user thereof tells her neighbors of the advantages of her new washer or vacuum cleaner or whatever she may have installed, and pretty soon three or four prospects are worked up for the first salesman to sell to. Should any of these happen to pass merchants' show windows, the chances are enquiries will be made as to price, etc., and if the customer is properly handled and the price is right, a sale will result. It is safe to say that instead of preventing merchants from selling goods, the Hydro Shop actually stimulates their trade in this particular line.

An instance of the recognized effect of Hydro Shop stimulus is manifest in Windsor where two of the largest manufacturers and dealers in electrical goods have shops adjacent to the Hydro Shop and their premises are none the less prominent in appearance, and the co-operation between the three is all that can be wished for. The Hydro Shop's primary object is not profit on merchandise sold but the promotion of the use of current and if it can assist its competitor to make a sale, all the help necessary is given.

If every Hydro Shop would make its establishment the most attractive in town, it would not be long before every dealer would commence to improve the appearance of his and try to benefit by the advertising so cheaply given by the Hydro Shop.

To accomplish the desired end in the matter of handling merchandise successfully, and to do the greatest amount of good to the largest number of consumers, it may become necessary to finance many consumers' purchases by the institution of the installment plan of payment, spreading the cost of an article over a period of time, thus making it possible for the consumer to purchase an appliance which he would otherwise perhaps not buy and, at the same time,

have it produce revenue for the local system by its use.

Most municipalities will have no trouble arranging the financial details to handle installment accounts, as much money is available from Hydro operation to swing quite a large business of this kind and where no funds are available, there is no doubt but that the banks would willingly make the necessary loans to the utilities.

The big thing to do is to open up a modern high-class Hydro Shop, to properly place before every consumer the possibilities in the electrical line and then to make it possible for him to put such things into use to create a demand for power and to produce revenue.

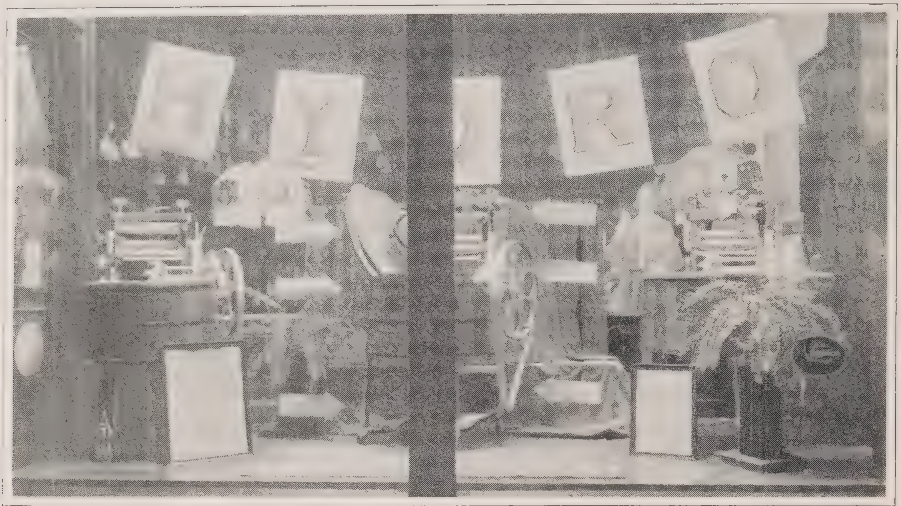
Let every Municipal Commission not now actively engaged in the game give the matter serious thought, and those only partly engaged go into it on the proper scale to ensure its ultimate success, because as was stated before every effort should be used to secure a market for the new supply of energy and much can be done in this direction by furthering the use of electrical appliances to the limit.

In the figures submitted many towns not on the Niagara System are included to show what has been done in other systems, where the need for development of the appliance business is just as great and quite as possible as on the Niagara System.

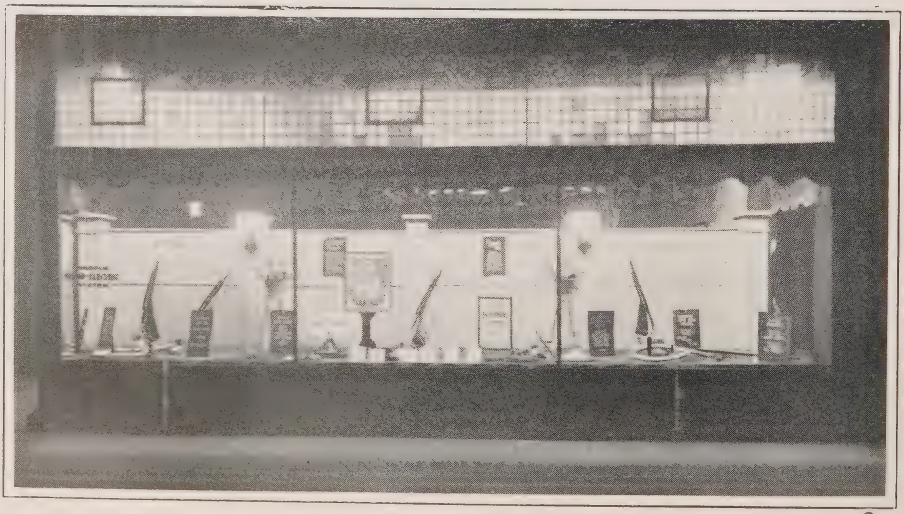
An Electric Cooking Exhibit made by the Chatham Hydro Shop.

Window displays like this one at Fergus have a definite sales value.

Attractive Hydro Exhibit at Peterborough



A window display at the Belleville Hydro Shop, featuring Kribs Washing Machines.



The Windsor Hydro Shop is always keenly alive to the value of "window selling." This is one of Windsor's recent displays.

Solving the Power Factor Problem.

By G. F. DREWRY,

Assistant Engineer, Hydro-Electric Power Commission of Ontario.

THE effect of power factor on the cost of supplying power has been given a great deal of study by engineers responsible for conditions, resulting from bad power factor and it may be of interest to give an actual example of the effect of bad power factor on a municipality buying power.

Take the municipality buying power on contract with the 90% power factor clause therein at $24.00 per h.p. assumed demand of 1,000 h.p. Power bill per month would be $2,000.00 provided the power factor was above 90%. If, however, the power factor was 80%, the bill would be $2,250.00 or an increase of 12½%.

The question is, who is to pay this increase of $225.00, the municipality or the ultimate consumer who causes the increased bill. Let us analyze the effect of the individual loads. The above municipality is buying the 1,000 h.p. at 80% power factor. Splitting the load into its various parts, we find that 300 h.p. is at 95% p. f., 300 h.p. at 85% p. f., 300 h.p. at 70% p. f., 100 h.p. at 65% p.f. These various loads totalled give 80% p. f. Who is the culprit? Not the customer with the 95% and not to any large extent the 85's. It is the 70's and 65's then, since they are responsible for the increased bill which the municipality pays, it is entirely logical that their bill should be increased proportionately. This is generally admitted. We are then brought up against the problem of how they can bill fairly and accurately and many efforts have been made to devise rates which would take care of this condition. All these rates however, lead us back to how to measure p. f. at the time of maximum demand. The only solution until quite recently was two graphic meters, one reading watts and one reading reactive Kva. This was an expensive method and could therefore be applied to large loads only. This in turn resulted in the p. f. on the large majority of customers being neglected altogether, which in turn led to the municipality paying the $225.00, above referred to, instead of the customers who caused the trouble.

Let us see how a customer's bill would be affected if p. f. were taken into consideration. Power is being sold by the above municipality at $1.50 per month per h.p. Customer "A" takes 50 h.p. and is being billed $75.00 per month, as his p.f. is thought to be 85% or above. Actually he is one of the 65's and his bill should be $97.30. Here is $22.30 toward the $225.00. Customer "B" takes 75 h.p. and is being billed $112.50 and his p. f. is also thought to be 85% or above. Actually he is one of the 70's and his bill should be $136.60. Here is $24.10 toward the $225.00. The remainder of the $225.00 would be obtained from

the other 65 and 70% p. f. customers, which means that the customer would in all cases pay his fair share of the costs of supplying power, irrespective of whether he operates on good p. f. or not.

How Can P.F. Be Measured?

In the March-April, 1921, Bulletin, page 72, a paper is given by Mr. Perry A. Borden, of the Commission's Laboratories, describing the measurement of maximum demand in voltamperes and the theory of a new device for measuring same. The purpose of this article is to show how this device can be connected. How once having obtained volt ampere demand measurement, the figures required for rendering the bill are obbill are obtained.

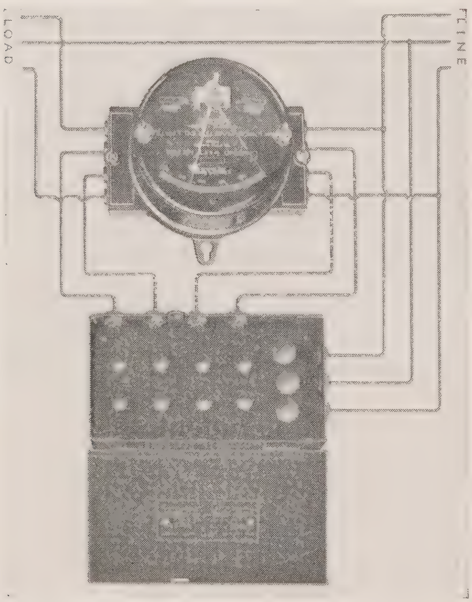


Figure 1

Figure 1 shows the V A D Transformer, as it is called by the Lincoln Meter Company, together with a Lincoln demand meter. By the addition of this small transformer any Lincoln meter can be made to register in Kva. of demand. The readings obtained from such an outfit under the present form of the Hydro-Electric Power Commission's Standard Interpretation of Rates, would be classified under three headings:

1. 10 h.p. and under when a p. f. of 80% is allowed.
2. Over 10 h.p. up to 100 h.p., in which case 85% p. f. is allowed.
3. Over 100 h.p. when 90% p. f. is allowed.

If it is known that power factors at time of demand are above the power factors allowed, then a demand meter reading in watts is all that is required but since this is very rarely the case on commercial motor loads, measurement in Kva. must be resorted to. Take class 1—if the meter with a V A D attachment connected, reads 7 Kva., 80% of this figure would be taken to represent a watt demand or 5.6 kilowatts.

Class 2. If the demand meter with the V A D attachment reads 60 Kva. since 85% p. f. is allowed, 85% would be taken as the demand reading in watts, which equals 51.

Class 3. In this case if the V A D outfit gives a reading of 200 Kva., 90% of the amount would be taken or 180 kilowatts demand.

To convert either of the three classes to h.p. it would be necessary to multiply the reading by $\frac{1000}{746}$

Figure 2 shows a diagram of connections with current transformers, a

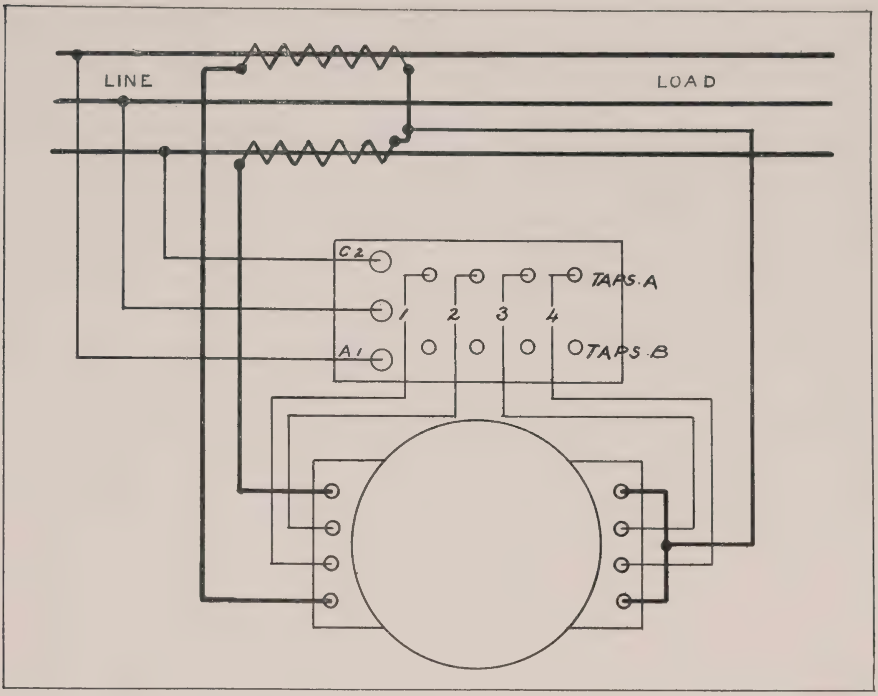


Figure 2.

Lincoln meter and a V A D. Two sets of taps are provided termed "A" and "B" taps. "A" taps cover power factors from 90 to 65% and the "B" taps 75 to 43%.

Generally speaking the power factor can be estimated with a sufficient degree of accuracy to determine which of these two taps should be used. If, however, this is not the case, two meters should be connected temporarily as shown in Figure 3, and the meter giving the higher reading at the end of a few days is the one which is correctly connected. The meter giving the lower reading may then be removed.

In an extreme case where very great variation of power factor at the time of maximum demand is expected, both meters may be allowed to remain permanently.

In connecting up a V A D, it is necessary to determine phase rotation. As was explained in Mr. Borden's paper, the purpose of the V A D is to lag the voltage applied to the meter, to a correct relation with the current, but if the phase rotation is in the wrong direction, then instead of lagging the voltage we will get a leading effect.

There are many ways of testing for phase rotation, but possibly the simplest is to adopt a rule of thumb method and use only a V A D transformer and a Lincoln meter.

If you are satisfied as to what the approximate power factor is going to be, you have

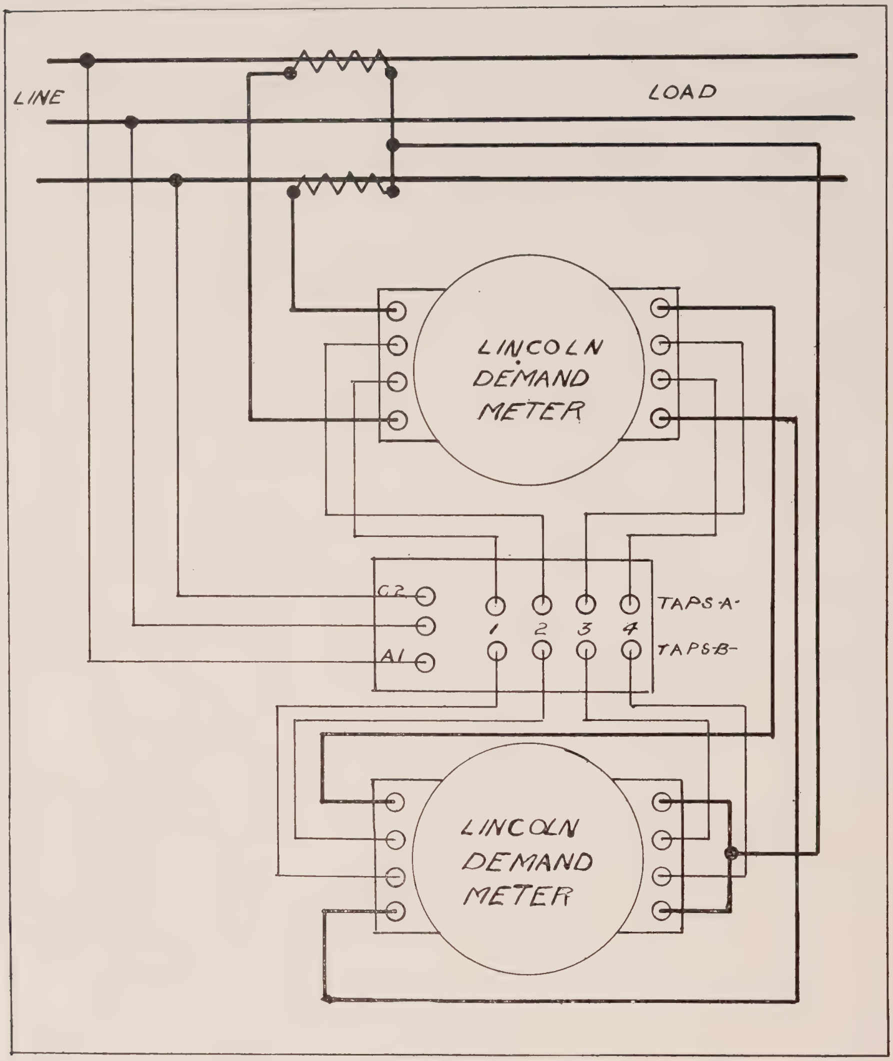


Figure 3

already picked out "A" or "B" taps as being the ones you are going to use. Connect up as shown in diagrams 2, 4 or 5, according to the instruments you are using with the outfit. Apply any reasonably constant load for 20 minutes. Note the indications of the red pointer on the Lincoln Meter. According to the power factor of the load you are using for test, you will get either a small reading, no reading at all or a negative reading if the phase rotation is wrong. If the phase rotation is right, true volt-amperes will be registered. In any event note your reading, then inter-

change leads "A" 1 and "C" 2. Interchange leads "1" and "2." Interchange leads "3" and "4." After making the three changes mentioned apply same load for 20 minutes and note the indications of the red pointer on the Lincoln meter. Here again you may get anything from a negative reading to a positive reading, depending on the power factor and whether your phase rotation is now correct or not. Finally the meter should be left with the connections which gave you the greatest positive reading or in

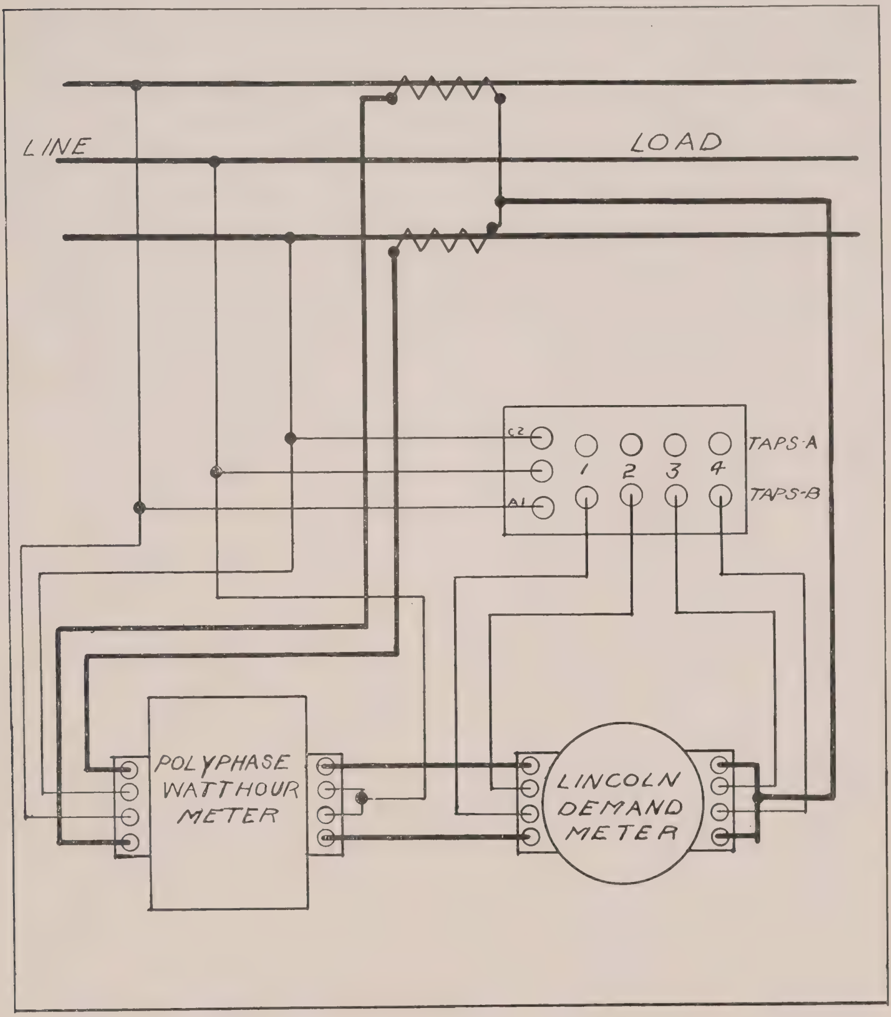


Figure 4—Diagram of connections, 3-Phase, 3-Wire V.A.D. Transformer and Lincoln Demand Meter measuring Volt-Amperes. Watt hour meter connected in series with Lincoln Meter on the secondaries of the current transformers and reading in Kilo watt hours.

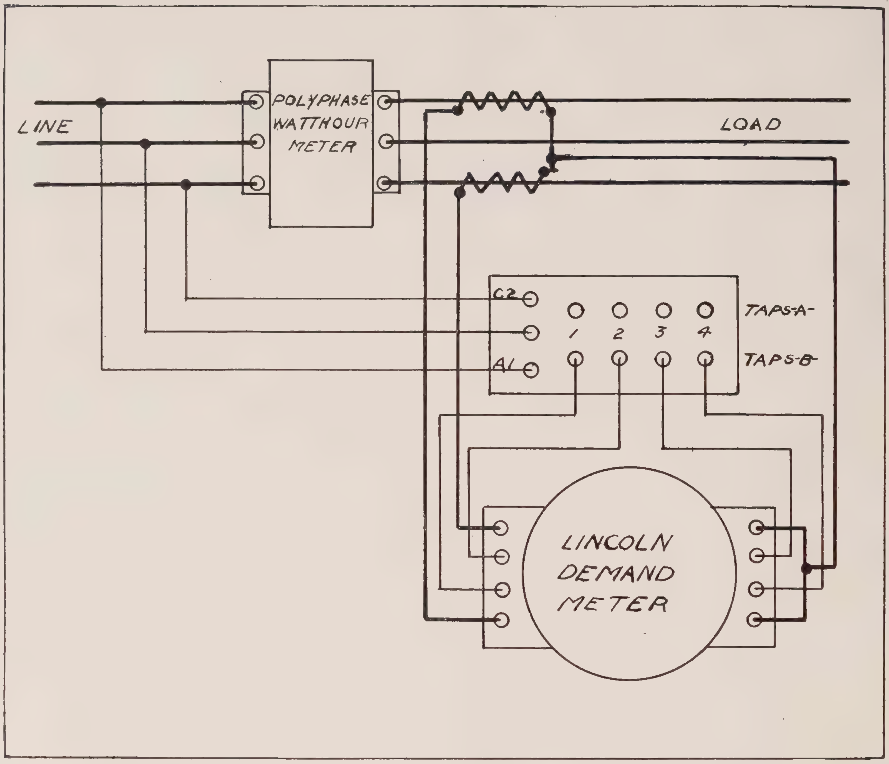


Figure 5—Diagram of Connections, 3-Phase, 3-Wire V.A.D. Transformer and Lincoln Demand Meter measuring Volt-amperes. Self contained Watthour meter measuring kilowatt hours.

other words the phase rotation is right when you obtain the high reading.

The standard V A D can be used on a 3 phase, 4 wire system and also on single phase if a 3 phase source is available for applying to V A D, also with the Lincoln graphic meter.

At first sight it may appear that the connecting of this apparatus is very complicated, but in practice, with a little experience, it is found that the procedure is reasonably simple and in view of the tremendous importance, both from an operating point of view and a revenue point of view, of billing for bad power factor, it is to be highly recommended that managers and superintendents adopt this method of measuring their demand and have their meter men familiarize themselves with this very considerable advance in the art.

Great Britain has three marine flags —the white ensign, flown only by ships of the Royal Navy and vessels of the Royal Yacht Squadron; the blue ensign, the flag of the Royal Naval Reserve; and the red ensign, the flag of the merchant service.

Power Progress in Canada.

While the increase in power development in Canada in 1920 was substantial, in many portions of the Dominion new installations and developments have not yet caught up with the ever-increasing demand for hydroelectric energy. Increase in power development naturally accompanies expansion of industries. The pulp and paper industry has undoubtedly attracted the greatest attention during the past year, but a large number of smaller industries and the ever-increasing uses of electricity for power and domestic purposes, both in urban and rural communities, are important factors in the increasing power demand. While the total water power installation of the Dominion at the commencement of 1920 was some 2,500,000 horsepower, the ultimate capacity of undertakings, either completed during the past year or under actual construction, will increase this total by some 840,000 horsepower. This figure includes the 500,000 horsepower Chippawa development of the Hydro-Electric Power Commission of Ontario. Additional projects aggregating some 360,000 horsepower are also under consideration.

The Province of Ontario leads with some 650,000 horsepower in undertakings, which are either under construction or completed; Quebec shows 140,000 horsepower; the Maritime Provinces, 30,000; Manitoba 20,000 horsepower.

Undertakings which are projected for the near future aggregate some 200,000 horsepower in Quebec; 15,000 horsepower in Ontario and 20,000 horsepower in the Maritime Provinces, while one project alone in British Columbia involves some 125,000 horsepower.—*L. G. Denis, Commission of Conservation.*

The Testing and Inspection of Concrete.

By R. B. YOUNG,
Assistant Laboratory Engineer, Hydro-Electric Power Commission of Ontario.

THE Commission is at the present time one of the biggest manufacturers of concrete on the continent. Before the completion of the Queenston Chippawa Power Development over half a million cubic yards of concrete will have been placed by the Commission in various structures. This means an expenditure for materials alone of over $3,500,000, and a cost for the labor and plant necessary to convert these materials into concrete of as much more. Obviously the Commission is interested in any means of cheapening a product of which it is such a large user and would be justified in undertaking any legitimate steps to this end.

Concrete is not a material of uniform quality. There is good concrete and poor concrete, and unfortunately the latter is not uncommon. Many concrete structures built but a few years ago are to-day showing unmistakable signs of disintegration. In order to safeguard its investment the Commission must demand that its structures be permanent and it is therefore vitally interested in the quality of the concrete of which they are

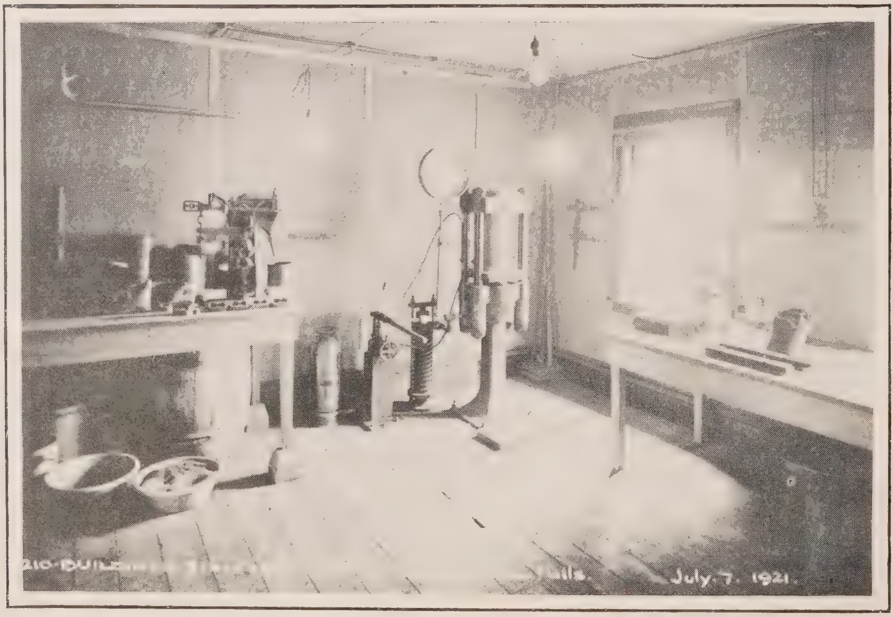


Figure 1—A typical field laboratory, Queenston-Chippawa Power Development

constructed. Any methods which will ensure high standards of quality would likewise be important

For these reasons the Commission some years ago began to study and develop the methods for inspecting and testing concrete and concrete materials and for their proportioning, mixing and placing in the field. The methods which it has adopted for all its work are the result of these studies. They are thought to be in advance of those of any other large concern in Canada if not in the world. These methods enable the engineers of the Commission to guarantee the quality of the concrete and in most instances to cheapen its cost.

The fundamental researches on which these methods are based have been carried out by the Laboratories. They have consisted of studies of methods of testing cement, sand and stone both for quality and for their concrete making properties; of dtermining the proportions of the these ingredients to obtain concretes of the desired strengths: of the effect of gradation, silt and impurities on the strength of concrete, of the laws governing the plasticity of concrete mixtures and of field methods of measuring, mixing, placing and inspection of concrete.

Concrete differs from nearly all other structural materials for it is manufactured upon the site of the structure of which it is to form a part. For comparison take its greatest rival, steel. The steel for a steel structure is manufactured in a highly organized steel mill under rigid control—it is fabricated in a well-equipped structural shop and on the job it is only assembled into place. In concrete the only manufactured material used is the cement—the rest of the ingredients are raw materials obtained locally and the whole is combined on the job to form concrete. Because of this it is not usually appreciated that the production of concrete is a manufacturing operation and should be handled as such.

It has been found in manufacturing that a uniformly high quality product can only be obtained with proper materials processed under the immediate supervision of experts. The same principle holds for concrete and for this reason the Commission maintains a system of rigid inspection of all materials and processes in its manufacture. The consequence of this has been that on High Falls, Nipigon and Queenston Chippawa Power Developments the concrete has been of an unusually high and uniform quality and the results have fully justified the precautions taken.

The method developed for the inspection and testing of cement has already been described in these columns. (See article by Mr. Mason in recent number of THE BULLETIN.) They consist in brief of mill supervision and sampling to enable the necessary tests to be carried out prior to the arrival of the cement on the job where it is to be used and of laboratory tests to determine its quality.

In testing sand and stone the same principle is followed. After preliminary studies have been made to determine the suitability of the material and its concrete making properties, periodic tests of the material as supplied are made to determine its gradation,

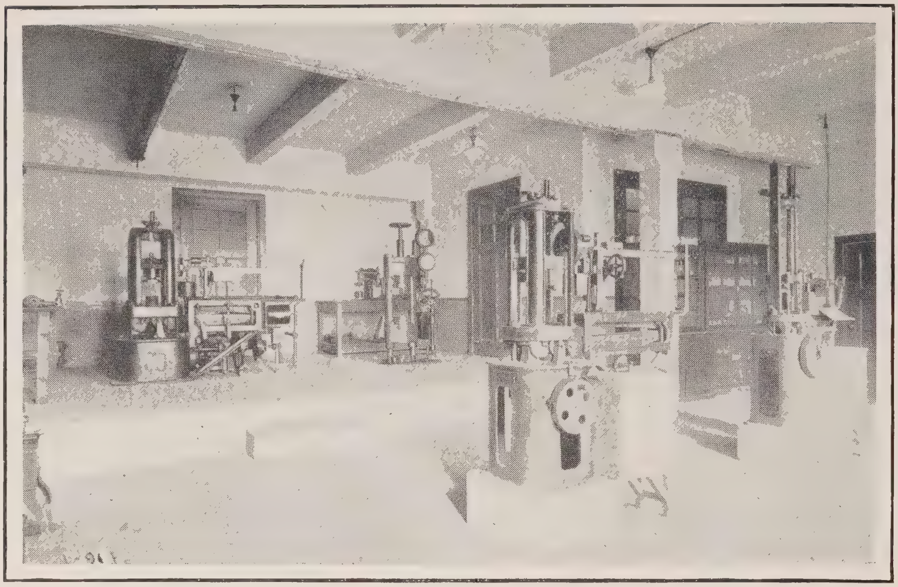


Figure 2—Machines used in testing structural materials, The Laboratories, Toronto.

cleanliness and the proportions of cement which must be used to attain desired results. Beside this, the sources of these materials are kept continually under observation.

The proportions of cement, sand, stone and water which under any given conditions will give concrete of the desired quality are determined by a method of proportioning known popularly as the Surface Area Method but which as used by the Commission, is somewhat different from the method properly called by that name. This modified surface area method was developed in the laboratories of the Commission as a result of its experimental investigations and researches. The method is simple and practicable and offers an effective way of setting proportions. A description of it is beyond the scope of this article and will be left to some future time.

The inspection of concreting operations includes all details in connection with proportioning, mixing and placing. An effort is made to see that all materials are accurately measured, that the batches are properly mixed and that the methods of placing are so arranged as not to interfere with the quality of the concrete delivered. Inspection is also maintained over the preparations preparatory to placing concrete, on its deposition in the forms, on the removal of the forms and on its final finishing.

As a check on the correctness of the proportions used and the methods pursued, specimens of the concrete produced are obtained for test periodically. The test specimens are six or

eight-inch cylinders. They are taken directly from the wet concrete already in place in the forms and are moulded and cured under standardized conditions. Some are tested when seven days old, others when twenty-eight days old, by crushing them to destruction in a hydraulic press and noting the force required to accomplish this.

Preliminary to actual construction the Laboratories examine all available materials and determine those suitable for use. When construction is about to begin they make further studies to determine the proportions which will give concretes of the different classes to be used. During construction a concrete engineer fro the Laboratories is assigned to the staff of the resident engineer in charge of the job to assist him with the concrete work. Thus at all times close contact is kept between the Laboratory and the field.

A Field Laboratory is installed on each of the larger jobs. This Laboratory is equipped with apparatus to carry out the necessary tests and to get the information needed in setting the proportions. The required apparatus is simple and of slight cost and requires but small space to house it. The tests likewise are simple and cheaply made. A typical Field Laboratory is shown in Figure 1.

The Concrete Laboratory of the Commission is very completely equip-

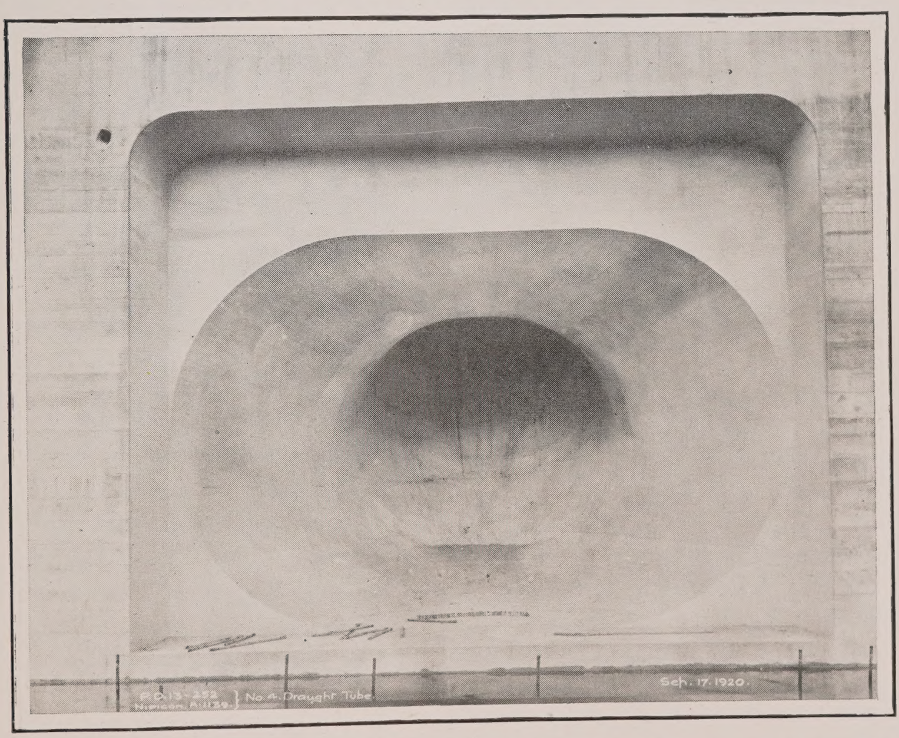


Figure 3—(a) Example of high quality concrete. (Draft Tubes) Nipigon Power Development.

ped for the investigation of problems in connection with concrete, and is staffed with men especially trained in this work. It is recognized every-

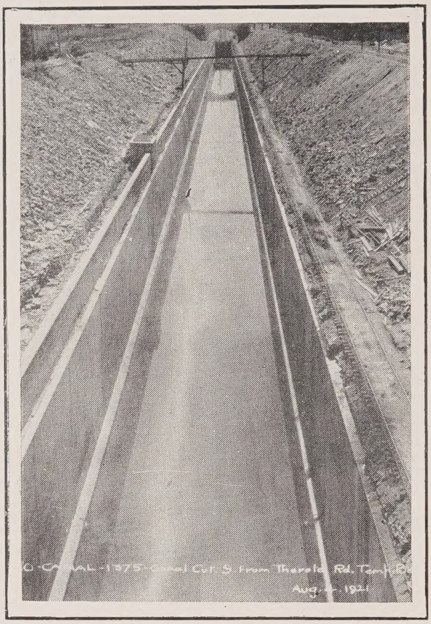


Figure 3—(b) Example of high quality concrete. (Canal lining, Queenston-Chippawa Power Development)

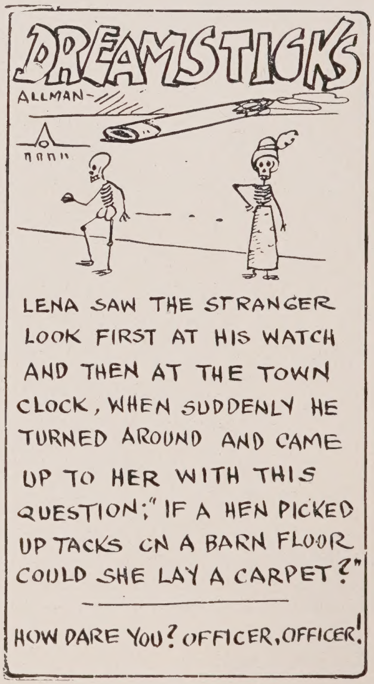
where as one of the leading centres of advanced desearch in concrete. The results of many of its studies have been published and requests for these publications have come from all parts of the world. In maintaining this work the Commission has, therefore, not only benefitted itself but also the public, for in assisting in the improvement and cheapening of a material used so largely in construction and especially in large public works, the public will in the long run derive the benefit.

DAMAGE BY RATS.

The United States has a rat problem, and some astounding figures are presented of the annual cost of this pest. India suffers more, for there are large sections of that country where religious scruples prevent the killing of even a rat.

Major J. C. C. Kunhardt, of the Indian Medical Service, has recently published the results of his survey of rat damage in India, and he puts the annual loss at 1,250,000,000, or about one-seventh of India's national income. —*The Nation's Business.*

During the past five years Canada's production of foodstuffs has increased in value from $825,370,500 in 1915 to $1,636,664,900 in 1920.



HYDRO MUNICIPALITIES

NIAGARA SYSTEM

	Pop.
Acton	1,563
Ailsa Craig	486
Ancaster	400
Ancaster Twp.	4,058
Aylmer	2,247
Ayr	802
Baden	710
Barton Twp.	6,382
Beachville	503
Biddulph Twp.	1,623
Blenheim	1,490
Bolton	587
Bothwell	680
Brampton	4,270
Brantford	32,159
Brantford Twp.	6,741
Breslau	500
Brigden	400
Burford	700
Burford Twp.	3,778
Burgessville	300
Caledonia	1,265
Chatham	15,182
Chippawa	1,172
Clinton	1,809
Comber	800
Copetown	230
Dashwood	350
Delaware	350
Dereham Twp.	3,200
Dorcester	400
Dorchester S. Twp.	1,376
Drayton	600
Dresden	1,411
Drumbo	375
Dublin	218
Dundas	5,009
Dunnville	3,517
Dutton	860
Elmira	2,392
Elora	1,205
Embro	437
Etobicoke Twp.	7,281
Exeter	1,445
Fergus	1,710
Flamboro E. Twp.	2,499
Forest	1,422
Galt	12,434
Georgetown	2,121
Glencoe	824
Goderich	4,220
Grantham Twp.	3,456
Granton	300
Guelph	17,032
Hagersville	1,072
Hamilton	114,766
Harriston	1,340
Hensall	721
Hespeler	3,000
Highgate	371
Ingersoll	5,385
Kitchener	21,056
Lambeth	350
Listowel	2,551
London	59,100
London Twp.	6,073
Louth Twp.	2,312
Lucan	620
Lynden	622
Markham	836
Merritton	2,553
Milton	1,800
Milverton	1,044
Mimico	2,887
Mitchell	1,656
Moorefield	335
Mount Brydges	500
New Hamburg	1,370
New Toronto	2,696
Niagara Falls	14,207
Niagara-on-the-Lake	1,918
Norwich	1,271
Norwich N. Twp.	1,879
Norwich S. Twp.	1,888
Oil Springs	473
Otterville	400
Palmerston	1,890
Paris	4,320
Parkhill	1,213
Petrolia	2,863
Plattsville	500
Point Edward	1,037
Port Colborne	3,235
Port Credit	878
Port Dalhousie	1,447
Port Stanley	717
Preston	5,184
Princeton	600
Ridgetown	2,150
Rockwood	520
Rodney	686
Sandwich	3,643
Sarnia	12,649
Scarborough Twp.	7,843
Seaforth	2,015
Simcoe	3,756
Springfield	420
St. Catharines	19,195
St. George	600
St. Jacobs	400
St. Mary's	3,886
St. Thomas	17,759
Stamford Twp.	4,000
Stratford	18,106
Strathroy	2,637
Streetsville	525
Tavistock	876
Thamesford	388
Thamesville	804
Thorndale	250
Tilbury	1,619
Tillsonburg	2,856
Toronto	499,278
Toronto Twp.	5,234
Townsend Twp.	2,988
Vaughan Twp.	4,184
Walkerville	6,279
Wallaceburg	4,067
Waterdown	791
Waterford	1,084
Waterloo	5,476
Waterloo Twp.	6,475
Watford	1,033
Welland	9,135
West Lorne	787
Wellesley	583
Weston	2,570
Windsor	31,629
Woodbridge	587
Woodstock	10,126
Wyoming	503
York Twp.	44,232
Zurich	457

Total—1,191,736

SEVERN SYSTEM

Alliston	1,264
Barrie	6,775
Beeton	571
Bradford	885
Camp Borden	....
Coldwater	595
Collingwood	7,262
Cookstown	635
Creemore	612
Elmvale	600
Midland	6,532
Orillia	7,854
Penetang	3,811
Port McNicoll	531
Stayner	915
Thornton	200
Tottenham	469
Victoria Harbor	1,441
Waubaushene	600
Total	41,552

WASDELL'S SYSTEM

Beaverton	949
Brechin	225
Brock Twp.	2,795
Cannington	838
Eldon Twp.	2,047
Gamebridge	70
Kirkfield	138
Mara Twp.	2,000
Sunderland	570
Thorah Twp.	1,084
Woodville	434
Total	11,150

NIPISSING SYSTEM

Callander	650
Nipissing	100
North Bay	10,163
Powassan	510
Total	11,423

MUSKOKA SYSTEM

Gravenhurst	1,437
Huntsville	2,160
Total	3,597

EUGENIA SYSTEM

	Pop.
Alton	450
Artemesia Twp.	2,367
Arthur	1,172
Chatsworth	303
Chesley	1,741
Derby Twp.	1,507
Dundalk	700
Durham	1,520
Elmwood	350
Flesherton	410
Grand Valley	582
Hanover	2,724
Holstein	285
Horning's Mills	350
Kilsyth	....
Kincardine	1,992
Lucknow	902
Markdale	869
Mount Forest	1,838
Neustadt	430
Orangeville	2,186
Owen Sound	12,218
Priceville	....
Ripley	....
Shelburne	1,063
Tara	520
Teeswater	852
Wingham	2,240
Total	39,571

OTTAWA SYSTEM

Ottawa	107,732

THUNDER BAY SYSTEM

Port Arthur	15,094

CENTRAL ONTARIO SYSTEM

Belleville	12,240
Bloomfield	600
Bowmanville	3,259
Brighton	1,376
Camden East Twp.	3,050
Cobourg	4,874
Colborne	869
Darlington Twp.	3,407
Deloro	259
Deseronto	2,017
Havelock	1,220
Kingston	23,261
Lakefield	1,133
Lindsay	7,841
Madoc	1,056
Marmora	856
Millbrook	740
Napanee	2,863
Newcastle	553
Newburgh	434
Norwood	698
Omemee	517
Orono	700
Oshawa	10,126
Peterborough	21,230
Pickering Twp.	4,382
Picton	3,165
Port Hope	4,394
Richmond Twp.	1,944
Seymour Twp.	2,506
Stirling	849
Trenton	5,736
Tweed	1,288
Wellington	853
Whitby	3,102
Whitby Twp.	1,734
Whitby E. Twp.	3,420
Total	134,552

ST. LAWRENCE SYSTEM

Alexandria	2,200
Apple Hill	....
Brockville	9,326
Chesterville	949
Lancaster	593
Martintown	....
Maxville	753
Prescott	2,774
Williamsburg	200
Winchester	1,019
Winchester Springs	....
Total	15,660

RIDEAU SYSTEM

Carleton Place	3,786
Kemptville	1,179
Lanark	583
Perth	4,047
Smith's Falls	6,665
Total	16,260

ESSEX COUNTY SYSTEM

Amherstburg	2,170
Canard River	50
Cottam	333
Essex	1,753
Harrow	619
Kingsville	1,732
Leamington	4,360
Total	11,017

THOROLD SYSTEM

Thorold	5,012

THE aim of The Bulletin is to provide municipalities with a source of information regarding the activities of the Commission; to provide a medium through which matters of common interest may be discussed, and to promote a spirit of co-operation between Hydro Municipalities.